Nov. 5, 1968 W. R. DAVENPORT ET AL 3,408,942

BILGE PUMP

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FIG. 1

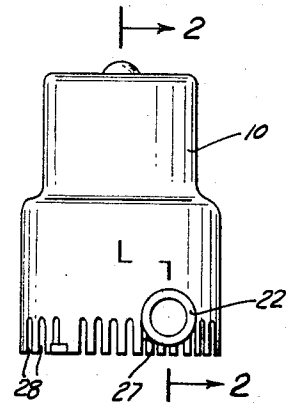

FIG. 2

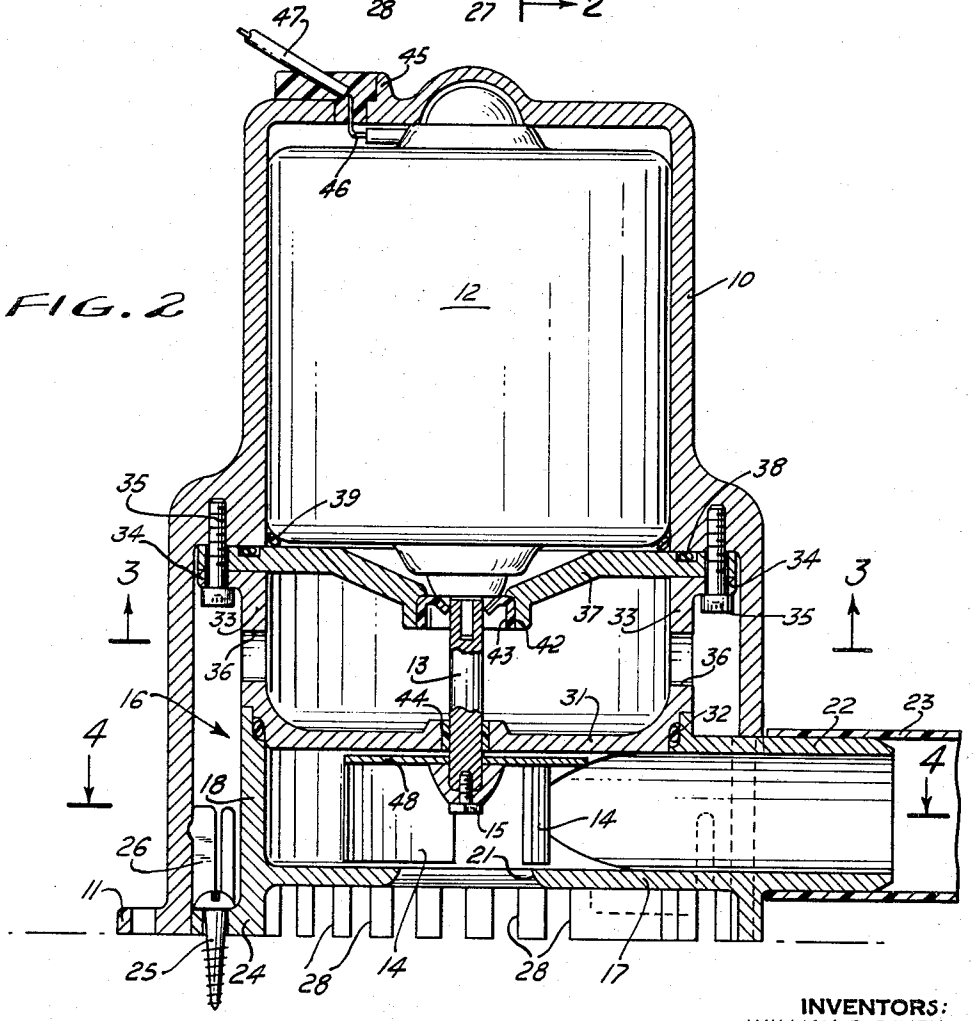

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FIG. 3

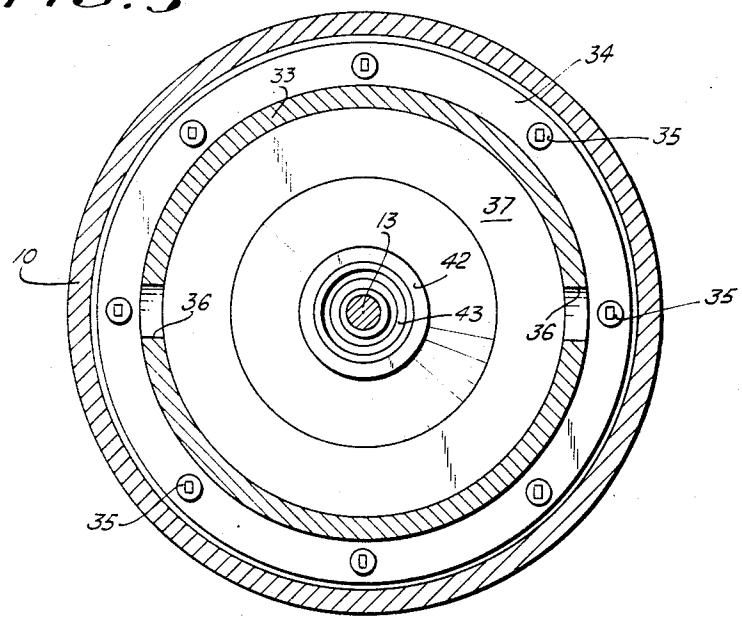
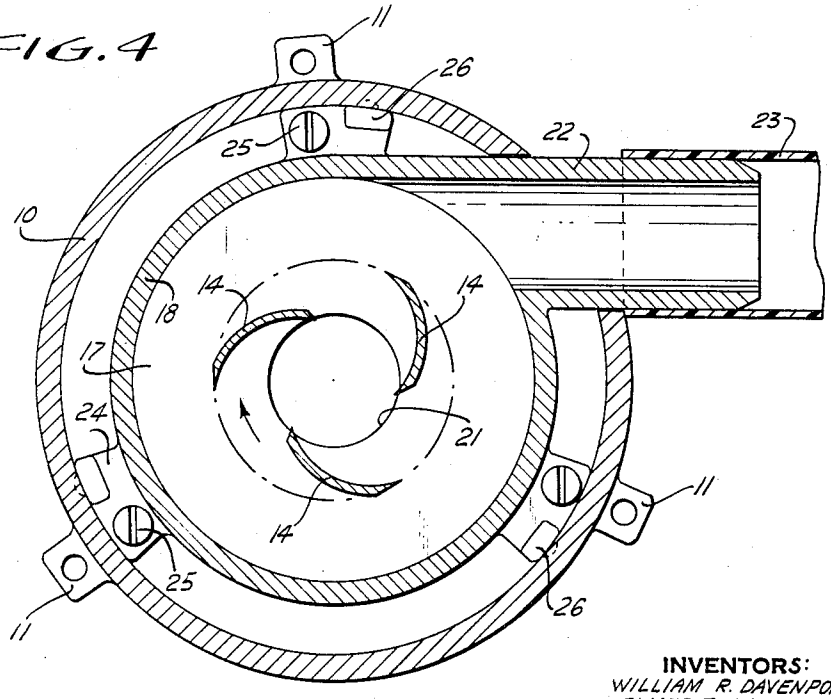


FIG. 4



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United States Patent Office 3,408,942 Patented Nov. 5, 1968

3,408,942

BILGE PUMP

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Filed May 23, 1967, Ser. No. 640,597
8 Claims. (Cl. 103—87)

ABSTRACT OF THE DISCLOSURE

An air-tight bell-shaped housing accommodates a motor in its closed upper portion, an impeller being mounted on the lower end of the motor shaft. A pump body within open lower end of housing, but unconnected thereto, defines impeller chamber. A pump cover, seated on pump body, is fixed to housing by walls extending upwardly from cover. Walls have holes for escape of liquid accumulating above the cover.

Plate fixed to housing below motor supports motor and mechanically seals it, in liquid-tight fashion, from lower part of housing.

This invention relates to pumps, and more particularly to pumps, such as bilge pumps, intended to remove water or other liquid from the bilge of a boat or the sump of a basement.

Such pumps, when in use, are partially or completely submerged in the liquid being pumped. Consequently, in the past, some pumps of this type have been provided with air-tight bell-shaped housings capable of trapping air within them. As the water level in the bilge rises, the pressure of the trapped air increases, whereby the air limits the level to which the water within the housing is permitted to rise. In this way, the pump motor mounted within the upper portion of the housing is kept out of contact with the water.

Known pumps of this type present certain problems in connection with maintenance and reliability which are overcome by the present invention.

It is an object of this invention to provide a bilge pump wherein the pump motor is separated from the liquid-engaging portion of the pump by both a trapped air volume and a mechanical liquid-tight barrier. As a result, should all or a major portion of the trapped air escape, such as by the pump accidentally overturning, the motor will be kept dry by the mechanical sealing means.

It is another object of the invention to provide such a pump wherein the pump housing may be readily lifted away from the pump body, i.e., the portion defining the impeller cavity, without disturbing the mounting of the pump body, so as to expose the impeller for repair or replacement, and expose the cavity for cleaning.

It is a further object of the invention to provide such a pump wherein the bushing which supports the impeller-carrying motor shaft as it passes through the pump cover is constantly lubricated by the liquid being pumped even after all the liquid in the bilge has been removed.

To achieve these objectives, the invention provides an air-tight, bell-shaped housing accommodating a motor in its upper closed portion, the motor shaft extending downwardly toward the open lower end of the housing. An impeller is carried by the lower end of the motor shaft, and a pump body, defining a cavity for the impeller, is located within the open lower end of the housing. The pump body is adapted to be secured to the support surface for the pump, but is unconnected to the housing. The bottom wall of a cup-shaped pump cover unit seats upon the pump body to close the impeller cavity, and the walls of the pump cover unit are secured to the

housing. Thus, the housing and the pump cover unit attached to it can simply be lifted away from the pump body to expose the impeller and impeller cavity.

A bushing preferably surrounds the portion of the motor shaft passing through the pump cover, and a small volume of the liquid being pumped squeezes upwardly between the bushing and shaft to lubricate them. The liquid partially fills the cup-shaped cover unit, and escapes back to the bilge through holes in the cup walls. A small amount of liquid remains in the cup after pumping has been completed and serves to continue lubricating the shaft and bushing should the pump continue to run. Of course, if the pump cover is made of suitable material, and the hole in the pump cover through which the motor shaft passes is so sized that the shaft fits snugly within the hole, the bushing could be eliminated.

A support plate for the motor is secured to the housing below the motor and above the pump cover. The plate incorporates mechanical, liquid-tight seals, including a seal surrounding the portion of the motor shaft passing through the support plate. The plate, therefore, forms a liquid-tight barrier between the motor compartment of the housing and the remainder of the pump. During normal operation, liquid at the outlet pressure of the pump does not contact the mechanical seals, nor does any liquid whatsoever. Therefore, the mechanical seals have a long life, and are ready at any time to serve their back-up function of keeping liquid away from the motor should the trapped air within the housing escape.

A feature of the invention is the manner in which the electrical conductors feeding the motor pass through the housing so as not to destroy its air-tight character. It has been found that when insulated wires extend through a hole in the housing, and the hole is plugged, air could nevertheless escape by flowing between each wire and its insulation. Consequently, in the present pump, the portion of the wires passing through the hole in the housing are stripped of insulation, and the hole is then plugged with a suitable material, such as an epoxy.

Other features and advantages of the invention will be apparent from the following description in which reference is made to the accompanying drawings.

In the drawings:

FIG. 1 is an elevational view of a pump according to this invention looking into the pump outlet;

FIG. 2 is a vertical cross-sectional view taken on line 2—2 of FIG. 1;

FIG. 3 is a horizontal cross-sectional view taken on line 3—3 of FIG. 2; and

FIG. 4 is a horizontal cross-sectional view taken on line 4—4 of FIG. 2.

In the description which follows, and sometimes hereinabove, the pump is referred to as a bilge pump, the region from which liquid is removed is referred to as the bilge, and the liquid being pumped is referred to as water. However, it is to be understood that the environment in which the pump may be used is not limited to boats, and liquid moved by the pump may be other than water.

The pump chosen to illustrate this invention includes a bell-shaped housing **10**, the top and side walls of which form an air-tight enclosure, but the bottom of the housing being open. The lower end of the housing side wall is formed with attachment feet **11** (FIGS. 1 and 4) projecting radially outwardly, by means of which the housing may be secured to the support surface for the pump, such as the bilge floor. Accommodated within the upper region of the housing is an electric motor **12**, having an output shaft **13** projecting downwardly toward the open lower end of the housing. A pump impeller **14** is secured to the lower end of the motor shaft **13** by means of a screw **15**.

Arranged within the lower, open end of the housing

10 is a pump body 16 having a bottom wall 17 and side walls 18. The pump body defines an impeller cavity within which the impeller 14 is located. The bottom wall 17 is provided with an inlet opening 21 though which water enters the cavity, and the side walls 18 are formed with a tangentially arranged outlet nipple 22 through which the pumped water leaves the cavity. A hose 23 may be attached to the nipple 22. The pump body 16 has legs 24 which space the bottom wall 17 above the bilge floor, and by means of which the pump body may be fastened to the bilge floor, such as by means of screws 25. Projecting upwardly from each leg 24 is a clip 26 having an outwardly facing, rounded protrusion adapted to snap into a detent in the inner surface of the housing side wall. The clips 26 help to position the housing 10 with respect to the body 16, but do not connect the two since the housing can readily be lifted off the pump body, in which case the clips slip out of engagement with the detents in the housing.

The lower ends of the housing side walls are provided with an enlarged slot 27 capable of passing over the nipple 22, and a series of smaller slots 28 through which water flows from the bilge to the pump inlet 21.

Seated upon the upper edge of the walls 18 is a cup-shaped pump cover unit, the bottom wall 31 of which serves as the top wall of the impeller cavity. An O-ring 32 forms a water-tight seal between the walls 31 and 18. The walls 33 of the cup-shaped unit extend upwardly, and terminate at their upper ends in an outwardly projecting flange 34 by means of which the unit is secured to the housing 10, as by screws 35. The walls 33 are provided with a pair of openings 36, the lower edge of each opening being spaced above the bottom wall 31 of the cup.

Also secured to the housing 10 by the srews 35 is a support plate 37 for the motor 12. The upper face of the support plate has an annular groove accommodating an O-ring 38 which forms a water-tight seal between the plate 37 and housing 10. The motor does not rest directly upon the plate 37, but instead rests against an O-ring 39 wedged between the motor, housing, and plate. The O-ring 39 does not serve as a seal but rather as a resilient shock absorber. The motor shaft 13 extends downwardly through a central hole in the plate 37 surrounded by a boss 42. Supported within the boss 42 is a suitable seal 43 which permits rotation of the shaft 13 with respect to it, but which produces a water-tight seal against the shaft.

The motor shaft 13 also extends through a central hole in the pump cover bottom wall 31, the hole being lined by a suitable bushing 44 which absorbs the reaction force on the impeller of the water leaving the pump. The bushing fits snugly around the shaft 13 and thereby limits greatly the amount of water which has a tendency to creep up the shaft 13 as the latter rotates. Nevertheless, the fit of the bushing around the shaft is loose enough to permit a small volume of water to flow between them.

The top wall of the housing 10 is provided with a hole surrounded by a low wall 45. The portions 46 of the electrical conductors, supplying current to the motor 12, which pass through the hole in the housing are stripped of insulation 47, and the hole and cavity defined by the wall 45 are filled with a suitable plastic, such as an epoxy material. Since the plastic comes into intimate contact with both the housing 10 and the uncovered wires 46, the air-tight character of the housing 10 is preserved.

When the pump is in operation, the impeller 14 is rotated by the motor shaft 13, and water from the bilge enters the inlet 21 and is pumped out of the outlet 22 and hose 23. Due to the presence of the plate 48 at the upper ends of the impeller blades, pump outlet pressure is present at the lower end of the bushing 44. Therefore, water seeps upwardly between the bushing 44 and shaft 13 thereby lubricating these parts. As the water accumulates in the cup, above the wall 31, it reaches the level of the openings 36, and flows back into the bilge. Consequently, it will be appreciated that, in normal operation, water never reaches the mechanical seal 43. Hence, this seal stays dry and free of dirt and grit often carried by the bilge water. Once the bilge is dry, the pump may be turned off. However, if through inadvertence the pump is left running, the water remaining above the wall 31 will slowly seep down between the shaft 13 and bushing 44 to keep these parts lubricated.

Should access to the impeller become necessary, the housing 10 is simply lifted upwardly, and of course the motor 12, shaft 13, impeller 14, plate 37 and pump cover unit 31, are raised as a unit with the housing. The pump body 16, on the other hand, remains fastened to the bilge floor. Since the cover 31 of the impeller cavity has been lifted, the cavity is open to view. Furthermore, the impeller 14 is exposed on the lower face of the wall 31.

If during the operation of the pump, the housing should accidentally become overturned, thereby allowing all the trapped air to escape, no injury can come to the motor 12 due to the mechanical water-tight barrier comprising the plate 37 and seals 38 and 43.

The invention has been shown and described in preferred form only, and by way of example, and many variations may be made in the invention which will still be comprised within its spirit. It is understood, therefore, that the invention is not limited to any specific form or embodiment except insofar as such limitations are included in the appended claims.

What is claimed is:

1. A pump comprising:
   (a) a housing having side walls and a top wall forming an air-tight enclosure, the lower ends of said side walls defining an opening into said housing.
   (b) a motor supported within the upper portion of said housing, the output shaft of said motor extending downwardly toward said opening,
   (c) an impeller secured to the lower end of the motor shaft,
   (d) a pump body adapted to be secured to a support surface for the pump, said body being within said housing opening but unconnected to said housing, and said body having bottom and side walls defining an impeller cavity, inlet and outlet openings for said cavity formed in said pump body,
   (e) a pump cover seated upon the upper edges of said pump body side walls in fluid tight relation and forming the top wall of the impeller cavity, the motor shaft passing through a hole in said cover, and
   (f) means for affixing said cover to said housing, whereby said housing and pump cover may be lifted as a unit away from said pump body to expose said impeller and impeller cavity for cleaning and repair.

2. A pump as defined in claim 1 including a bushing lining the hole in said pump cover, said bushing fitting snugly around the motor shaft but permitting a low-volume portion of the liquid being pumped to pass upwardly between the shaft and bushing when the pump is pumping the liquid, whereby said bushing is lubricated by the liquid.

3. A pump as defined in claim 1 wherein said affixing means (f) includes a wall secured to said pump cover and projecting upwardly therefrom, and fasteners securing said wall to said housing.

4. A pump as defined in claim 3 wherein said pump cover and pump cover wall are integrally formed as a cup-shaped member.

5. A pump as defined in claim 4 including an opening in said pump cover wall through which liquid which flows upwardly through the hole in said pump cover may escape from said cup-shaped member.

6. A pump as defined in claim 5 including a bushing lining the hole in said pump cover, said bushing fitting snugly around the motor shaft but permitting a low

volume portion of the liquid being pumped to pass upwardly between the shaft and bushing and into said cup-shaped member, and wherein said opening in said pump cover wall is spaced above said pump cover so that a volume of the liquid remains in said cup-shaped member even after the region in which the pump is located is dry whereby said remaining liquid serves to lubricate said bushing should the pump continue to run.

7. A pump as defined in claim 1 including a motor support plate secured to said housing in liquid-tight relation below the motor body and above said pump cover, a hole in said plate accommodating the motor shaft, and a liquid-tight seal within said support plate hole and engaging said shaft.

8. A pump as defined in claim 1 including a hole

in said housing through which electrical conductors extend to said motor, the portions of said conductors passing through said hole being free of insulation, and a mass of plastic plugging said hole and surrounding said conductors in air-tight relation.

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